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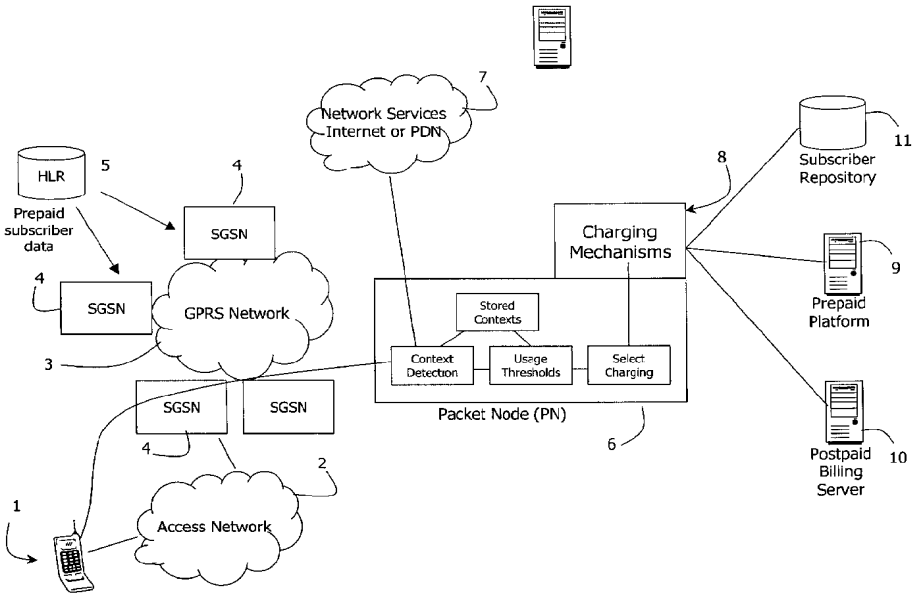

(57) Abstract: A pre-paid packet node (PN, 6) emulates a GGSN in a GPRS network (3). It receives packet data session data from SGSNs (4) and performs centralised interfacing with pre-paid platforms (9, 10, 11). It determines from the session data a context to choose a charging mechanism. The charging mechanism governs how the packet node (6) monitors service usage in communication with the relevant charging platform. It monitors data services usage according to contexts received from the platform (8).

WO 03/047164 A2

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"Control of Services in Mobile Packet Data Networks"

INTRODUCTION

Field of the Invention

The invention relates to provision of services in mobile packet data networks.

Prior Art Discussion

There is at present a shift in the mobile network field towards provision of higher bandwidth for data services by incorporating packet data capabilities into the mobile network infrastructure. Standards now exist for overlay of packet data capabilities into mobile networks based on GSM, TDMA, CDMA, UMTS and other technologies. Packet data capabilities provide higher bandwidth services as available bandwidth is shared between multiple subscribers in a similar way as occurs in fixed networks, for example IP-based networks underlying the Internet. Packet data capabilities will also be available to mobile subscribers by arranging interoperability between emerging Wireless LAN technologies (802.11, HiperLAN) and mobile network infrastructure. This invention applies to any packet data networks requiring both prepaid and post-paid access, for example CDMA, TDMA, UMTS, WLAN and even fixed LAN access.

There has been significant growth in the use of pre-paid access to mobile network services in recent years. At present, pre-paid access is provided primarily for voice and SMS services using specialised pre-paid platforms that become part of the mobile operator's network infrastructure. As mobile operators add packet data capabilities to their networks there is a need to support pre-paid access to data services delivered over the packet data system.

Flexible charging mechanisms are now required by mobile or wireless operators as the range of data services becoming available over packet data networks means that it is no

longer feasible for an operator to apply the same charging model to each individual data service. For example, a mobile operator should be able to apply distinct charging models for distinct services such as: web browsing, ringtone or game download (which may attract a premium charge), send an MMS, receive an MMS (which may be free), etc. Furthermore, the operator may wish to apply different tariffs for such operations at different times, for example based on time of day, day of week, etc. in order to influence traffic patterns.

The invention is directed towards allowing mobile operators to offer pre-paid or post-paid access to packet data services for mobile subscribers in a more versatile manner. It is further directed towards providing a high degree of flexibility for the mobile operator in a) determining whether the current user operation is chargeable or not and, b) selecting the appropriate charging mechanism to apply to the current user operation. It addresses these requirements for a range of packet network technologies, including those used for GSM, CDMA and Wireless LAN.

SUMMARY OF THE INVENTION

According to the invention, there is provided a method of controlling data services usage in a mobile data network, the method comprising the steps of:

a network service node routing a subscriber packet data session to a packet node;

the packet node inspecting the packet data and determining a current context of the data session;

the packet node determining a charging mechanism according to the current context; and

the packet node monitoring service usage according to the charging mechanism and notifying a charging platform for charging the subscriber.

In one embodiment, the packet node determines a charging mechanism according to the current context and subscriber information determined from inspecting the packet data session.

In another embodiment, the packet node selects one of a plurality of pre-stored charging mechanisms.

In a further embodiment, the packet node, dynamically receives monitoring usage parameters from the charging platform during the session.

In one embodiment, the packet node invokes an operation on the charging platform when a usage parameter threshold is exceeded.

In another embodiment, the method comprises the further step of the charging platform transmitting an instruction to the packet node instructing a change of the current context, and the packet node changing the context accordingly, and dynamically changing the charging mechanism in response to the context change.

In a further embodiment, a network service node selects the packet node for routing the packet data session according to a subscriber record.

In one embodiment, the subscriber record includes an address of the packet node in an access name field.

In another embodiment, the charging mechanism causes the packet node to initially request authorisation from the charging platform for full activation of a context.

In a further embodiment, a single authorisation relates to a plurality of usage thresholds.

In one embodiment, the packet node switches from one tariff to another for usage monitoring and dynamically updates usage thresholds accordingly.

In another embodiment, the packet node switches tariffs in response to an instruction from the charging platform.

In a further embodiment, the packet node splits a charging increment into portions separated by a tariff switch event.

In one embodiment, the packet node holds previous contexts and subsequently re-establishes at least one previous context.

In another embodiment, the charging platform is a prepaid platform, and the packet node notifies the prepaid platform of usage sufficient to decrement a subscriber's account.

In a further embodiment, the charging platform is a post-paid billing platform and the packet node notifies the billing platform of usage sufficient to calculate a charge against the subscriber's billing account.

In one embodiment, the network is a GPRS network, and the packet node emulates an SGSN or a GGSN.

In another embodiment, the packet node dynamically chooses one of a plurality of charging platforms according to the selected charging mechanism.

In a further embodiment, an MMSC includes a charging indicator in a URL for sending or receiving a multi-media message, and the packet node uses this indicator to determine a charging mechanism.

In another aspect, the invention provides a packet node comprising means for performing packet node operations of a method as defined above.

In a further aspect, the invention provides a charging platform comprising means for performing charging platform operations of a method as defined above.

DETAILED DESCRIPTION OF THE INVENTION

Brief Description of the Drawings

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only with reference to the accompanying drawings in which:-

Fig. 1 is a schematic diagram illustrating interaction between a wireless data network (GPRS), a pre-paid packet node and a number of external platforms, including a pre-paid platform, a post-paid billing platform and a subscriber repository; and

Fig. 2 is a diagram illustrating prepaid or post-paid services charging control.

Description of the Embodiments

Referring to Fig. 1, a pre-paid mobile subscriber 1 uses a GSM access network 2 to attach to a GPRS packet data network 3 via an SGSN 4. There may be several SGSN's in the network. The SGSN's in the network are equipped with signalling interfaces to allow them to request subscriber data from the Home Location Register (HLR) 5 for the network. Also connected to the GPRS network is a packet node (PN) 6, which in this embodiment is configured to appear as a standard GGSN to the GPRS network. Acting as a GGSN, the PN is responsible for providing a gateway for control of services to pre-paid and post-paid mobile subscribers to packet-based network services, the external

Internet or other PDN's 7, i.e. all packet data flowing between the mobile subscriber and internal services or the Internet/PDN can be directed to flow via the PN. A set of charging mechanisms, 8, are hosted on the PN or alternatively on an external platform that may be connected to the PN. Finally, a number of external platforms including a pre-paid platform 9, a post-paid billing server 10, and a subscriber repository 11 are connected to the PN. These platforms manage a pre-paid subscriber's credit, a post-paid subscriber's charges, and are used to determine authorisation for pre-paid and post-paid subscribers to various network services such as voice calls, packet data services, MMS and SMS.

The PN implements a context detection and packet data metering capability. These capabilities may lead to invocation of queries or events towards an external platform such as a pre-paid platform. The format of these queries or events is adapted according to existing standards in the network where the PN is deployed. The invention also introduces a set of operations to be implemented at the external platform that, in conjunction with the PN features, allows flexible pre-paid access functionality to be implemented. An implementation of the invention in the context of a GSM mobile network is described below.

The packet data technology adopted for GSM mobile networks is known as GPRS (General Packet Radio Services). This technology is implemented by two nodes in the GSM network - a Serving GPRS Support Node (SGSN) and a Gateway GPRS Support Node (GGSN). The standardised prepaid GPRS service uses triggers set at the SGSN (based on CAMEL Phase 3 according to GPRS standards). This invention introduces the PN, which in this embodiment, appears to the network as a standard GGSN. The network service nodes are configured to route pre-paid data streams to the PN, where the PN determines the current context, selects the appropriate charging mechanism and the corresponding pre-paid operations are invoked on the pre-paid platform. The PN meters the subscriber's usage of data packets within the current context based on the response from the pre-paid platform, and invokes further operations on the pre-paid platform

when a subscriber's current usage threshold is reached. In this example, the invention delivers a number of advantages to the mobile operator.

The PN can use the current context to determine the charging mechanism to be applied to the current user operation, e.g. the operation may be free, it may attract a premium charge, or it may be subject to data volume or time-based charging. Furthermore, the PN is able to use the context and charging information to invoke the appropriate operations on the associated pre-paid platform. In this way, the PN can be configured to support a wide range of charging mechanisms that may apply to different data services and different classes of subscribers. This flexibility allows the mobile operator to introduce differentiated tariff and charging schemes, according to the characteristics of the service being offered to the subscriber. The operator may use this flexibility to match service pricing to the perceived value of the service to the subscriber, or even as a means to control demand for a service, e.g. the operator may stimulate demand for a new service by initially offering free access, or create premium services targeted at specific market segments.

Another important feature of the PN is its ability to support tariff change events from the external pre-paid or post-paid platform. When a tariff change event is received, the PN dynamically updates all contexts currently active in the PN so that the charging mechanisms applied to those contexts reflect the most recent tariffs applicable since the tariff change event.

The invention offers more flexible tariff and charging mechanisms than would be possible using the prior art pre-paid solution based on CAMEL triggers in the SGSN. In addition, it allows the operator to avoid expensive upgrades to SGSN nodes in the network as well as potentially expensive upgrades to the pre-paid platform to support the standard CAP/SS7 interface. Context detection at the PN provides greater control over pre-paid charging mechanisms than the standard CAMEL approach of arming triggers. The PN also provides a central gateway, simplifying management of the pre-paid packet

service. The operator benefits from reduced capital and operational costs and enhanced performance at the SGSNs as they no longer have to process IN transactions.

Similar advantages are provided to network operators when the invention is deployed in networks based on alternative technologies such as CDMA or Wireless LAN. In the case of the wireless LAN standards (802.11x, HiperLAN/2 etc.) there is no defined mechanism for invoking differentiated charging mechanisms for either pre-paid or post-paid subscribers, and accounting for subscriber usage thresholds etc. In this case the PN provides a method for implementing differentiated charging in such domains for both pre-paid and post-paid users.

The invention therefore provides a common, simplified architecture for provision of differentiated charging for pre-paid and post-paid packet-data services in a wide range of mobile packet data network technologies, including GPRS, CDMA and various Wireless LAN technologies. This invention can also provide prepaid packet data services for fixed packet data networks such as corporate LANs/WANs and virtual private networks (VPNs).

The PN includes a context detection mechanism that can be activated upon certain events regarding the packet data stream flowing through the node. Furthermore, there is a set of charging mechanisms, which may reside internally in the PN or externally on a separate platform, and which the PN may invoke according to the current context. There is also a set of operations contained in either a pre-paid or post-paid platform, external to the PN, and which can be activated by the charging mechanism selected by the PN for the current context. These operations allow the pre-paid or post-paid platform to authorise and control access by a subscriber to packet-data services. Also, the PN has metering and control capabilities that allow it to apply authorisation and control operations communicated by an external platform, for example usage threshold limits, or a tariff change event.

A GPRS subscriber has GPRS subscription data stored in the HLR. The subscription data contains zero or more PDP context subscription records. Each PDP context subscription record contains an Access Point Name field (APN). The APN is a label defined according to the DNS naming convention that describes the access point to the external packet data network. In the case of GPRS networks the APN is the address of the GGSN that connects to the external packet data network. In the case of GPRS subscribers subject to charging control as defined here, the APN is defined as the address of a PN for all PDP context subscriptions. To provide scalability within a network, one or more PN's may be deployed in the network and subscriber activation's may be statically or dynamically distributed across these PN's. When a GPRS device attaches to the SGSN, or when other location management functions take place then the HLR performs an Insert Subscriber Data procedure. The Insert Subscriber Data procedure downloads the GPRS subscription data to the SGSN for the relevant PDP contexts.

The PN is configured to appear to the GPRS network as a standard GGSN. When a pre-paid mobile subscriber requests the activation of a packet data session (known as a Packet Data Protocol (PDP) Context in GPRS), the request is therefore forwarded to the PN based on the APN address information previously downloaded to the SGSN by the HLR.

At the PN the PDP Context activation request is received and standard network procedures can be invoked by the PN to authenticate the subscriber. In addition to the standard procedures, the PDP Context activation request is also detected by the context detection mechanism in the PN (which may use both the request and subscriber information in determining the context), causing it to invoke a charging mechanism associated with that context and issue an event to the pre-paid or post-paid platform, requesting authorisation for activation of the PDP Context for the pre-paid subscriber.

When the event is received by the pre-paid or post-paid platform, it performs a check on the subscriber, for example, credit balance for a pre-paid subscriber, or current usage threshold for a post-paid subscriber. If the subscriber's service is authorised, the PDP

Context activation can be authorised. To provide real-time control of the subscriber's access to packet-data service, the pre-paid platform allocates a pre-configured service increment (a data volume allocation, or a session duration allocation) for the new data session. If it is a pre-paid subscriber, it performs a rating function and reserves the corresponding amount of credit from the subscriber's account. A successful authorisation response returns an indication of the authorised service increment to the PN.

At the PN, when the service increment indication is received it immediately enables the metering and control functions that will monitor the subscriber's usage of the packet data service. These metering and control functions are activated and deactivated directly by the charging mechanisms invoked according to the current context identified by the PN. When the authorised service increment is exhausted, the currently active charging mechanism issues a request to the pre-paid or post-paid platform for further authorisation of packet data service for the subscriber. If the subscriber terminates the PDP Context before the authorised service increment is exhausted, the charging mechanism associated with this context may send the corresponding event and usage information to the pre-paid or post-paid platform, if appropriate.

At the pre-paid or post-paid platform, if a new authorisation request is received from the PN, the platform confirms the debit of the reserved amount from the subscriber's credit balance (pre-paid subscriber) or may issue a charging record against the subscriber's account (post-paid subscriber). The platform then performs a new authorisation calculation and calculates new usage thresholds which can be returned to the PN. If the event received by the pre-paid or post-paid platform indicates termination of the PDP Context, a rating function is performed on the usage information and the corresponding total is confirmed as a debit from the subscriber's credit balance (pre-paid) or a charging records is issued (post-paid), - in both cases the unused portion of the reserved credit amount is effectively returned to the subscriber's account.

It is possible that a subscriber's PDP Context may start during one tariff period, and continue into a subsequent tariff period (where usage of packet data services may be

charged at a higher or lower rate than at the time when the PDP Context was activated). To provide for this eventuality, a tariff change request may be generated in the pre-paid or post-paid platform. This request is sent to the PN whenever a new tariff period is entered and allows the service increments for PDP Contexts currently active to be updated in accordance with the tariffs in force in the new tariff period.

Some sample usage scenarios are provided below to illustrate the operation of the context detection and charging mechanisms.

1. Browsing Context.

A GPRS subscriber establishes a PDP context and connects to a mobile web portal, which may be provided by the network operator or may be an independent portal freely accessible via the internet. The user browses from the mobile web portal to a variety of sites and performs a number of web searches.

The PN examines the data stream and is able to identify a browsing context based on the protocol being used (HTTP), the operations invoked by the user (GET, POST), and the URL's accessed. Once the browsing context has been identified, the PN may use information from the subscriber's profile to determine issues such as class of service, pre-paid or post-paid subscription, etc. Based on the combination of context and subscriber information, the PN selects and invokes a charging mechanism appropriate for the current context from a set of previously configured and installed charging mechanisms. For example, a charging mechanism appropriate for pre-paid subscribers in a browsing context requests authorisation for the session from the pre-paid platform, receives some usage thresholds from the pre-paid platform (e.g. a maximum data volume before re-authorisation is required). This information is returned to the PN which monitors the usage thresholds while the browsing context remains active.

2. Premium Content Context.

During a browsing session the GPRS user accesses a known premium content site for example, providing ringtones or graphic images to subscribers.

The PN detects a change of context when it recognises that a HTTP operation is invoked on a URL that represents a known premium content site. With the change in context, the PN selects a new charging mechanism appropriate to the new context. A new charging mechanism appropriate for pre-paid subscribers accessing a premium content site requests authorisation for access to the premium content site from an external platform (e.g. by checking service authorisations in a subscriber profile stored in a central subscriber database).

3. File Download Context.

A GPRS user selects a particular content item for download, such as a ringtone or a graphic image. The PN detects a change of context by recognising that a HTTP operation is being invoked on a URL representing a content file. Alternative indicators of a file download scenario include recognising the initiation of a FTP file transfer. The content URL may also contain a token representing the premium charge associated with the content. The PN selects the charging mechanism appropriate to this context. An authorisation request for the subscriber to incur the premium charge associated with the content is sent to the pre-paid platform. The pre-paid platform may return usage thresholds to the PN (e.g. max. value of premium content downloads from this site, max. size of files allowed, etc.). This would enable the charging mechanism to enable several download operations from this site without requiring a new authorisation request. The new usage thresholds are returned to the PN which applies these thresholds while the content download context is active. Note that the previous usage thresholds for the browsing context may be disabled while the download context is active, or may remain enabled according to the pricing models specified by the network operator.

The PN continues to monitor the data stream during the download operation. If the PN detects that the download operation has completed successfully, the PN invokes the charging mechanism which then confirms a charge to the pre-paid platform (pre-paid subscriber) or generates a charging event (post-paid subscriber). If the PN detects that the

download operation failed to complete, no charge is allocated by the PN to the subscriber.

4. MMS Send Context.

An MMS context is defined to enable a network operator to introduce different charging models for MMS service and enable the network operator to specify whether packet data charges should apply or not to MMS operations . Possible charging models include: sender pays fixed fee for sending with no charge to receiver; sender pays volume related fee for sending and no charge to receiver; sender pays volume related fee for sending and receiver pays volume related fee for receiving; etc.

A GPRS user invokes an MMS send operation from a GPRS connected MMS handset.

The PN detects the MMS send context from the HTTP operation (POST) and the URL (known URL for MMS service). As an additional feature of the invention, the MMSC is configured to embed a token in the URL representing a charge indicator for the send MMS operation, for example this may be used to indicate whether packet data charges should apply or not to the MMS send operation. Using the context information, charge indicator in the URL and subscriber information, the PN selects a charging mechanism appropriate to the MMS send context. The charging mechanism may send a charge authorisation request to the pre-paid platform (for pre-paid subscribers) and determines usage thresholds that apply to the MMS send operation. The usage threshold information is returned to the PN, which may use this, for example, to suspend data volume counters while the MMS send context is active.

5. MMS Receive Context.

A GPRS handset receives a notification that an MMS message has been received. The handset invokes an MMS receive to retrieve the MMS from the MMSC over the GPRS network.

The PN detects the MMS receive context from the HTTP operation (GET) and the URL (known URL for MMS service). As an additional feature of the invention, the MMSC is configured to embed a token in the URL representing a charge indicator for the receive MMS operation. For example, this may be used to indicate whether packet data charges should apply or not to the MMS receive operation. Using the context information, charge indicator in the URL and subscriber information, the PN selects a charging mechanism appropriate to the MMS receive context. The charging mechanism may send a charge authorisation request to the pre-paid platform (for pre-paid subscribers) and determines usage thresholds that apply to the MMS receive operation. The usage threshold information is returned to the PN, which may use this, for example, to suspend data volume counters while the MMS receive context is active.

When a new context is detected and established within the PN for a subscriber, the previous context may remain in the PN but be marked as inactive. This allows the PN to rapidly re-establish a previous context and apply remaining usage thresholds for that context without requiring the appropriate charging mechanism to generate a new authorisation request. The maximum number of inactive contexts that may be maintained by the PN for each individual subscriber can be configured in the PN. If this threshold is exceeded, the PN is configured to discard the oldest inactive context, generating a charge confirmation report to the appropriate external platform, before adding a new context to the inactive list.

For the PN a packet data session, is divided into intervals representing the periods between successive authorisation requests (and their associated usage thresholds). When the session is established and service authorisation is granted, a service increment (a certain amount of data or time) is determined for the subscriber's session. Once this threshold is reached, a new service authorisation request is invoked from the PN and, if successful, another service increment is allocated to the session. For example, for a pre-paid subscriber a new authorisation request is sent to the pre-paid platform, which grants the authorisation based on the subscriber's current credit balance and returns usage thresholds that apply to the user's session.

As illustrated in Fig. 2, each charging interval begins with a service authorisation request from a charging mechanism and ends with a charge confirmation report by the charging mechanism and a new authorisation request when the allocated service increment is exhausted. A charging interval may be terminated by the PN before the allocated service increment has been used if the context is terminated for any reason, for example the user terminates the current session.

In many networks, the tariff charged by the operator for data services may vary according to the time of day or day of the week. Special tariffs may be introduced over holiday periods or as a result of marketing initiatives. Such changes in tariff affect the current set of contexts stored in the PN at the time that the tariff switch takes place. A feature of this PN is its ability to manage such tariff switch events and to invoke a dynamic update of usage thresholds in the current set of contexts to reflect the new tariff regime in a controlled manner.

When the PN receives a tariff switch event it immediately stores current usage levels for all stored contexts and restarts metering of subscriber usage with appropriately reduced service increment thresholds. In this case the charging interval splits into two portions separated by the tariff switch event. The PN now generates charge confirmation reports for all stored sessions using a congestion control process to ensure that the events are spread out over an interval to ensure that no congestion condition occurs at the external platforms.

An example congestion control process is described here. The PN retains an internal table of all stored contexts and current usage levels as registered when the tariff change event was received. The PN calculates a delay threshold based on the number of stored contexts in the table, and a maximum allowed period for completing processing of the tariff change event (this is a configurable parameter that can be set by the network operator). The PN begins processing the contexts stored in the internal table as follows:

- Starting with the first context in the table, the PN generates a charge confirmation report consisting of the usage level registered when the tariff change event was received, and the current usage level as metered since the tariff change event.
- The external platform responds to the charging event in the normal way, returning a new usage threshold based on the new tariff rates in force since the tariff change event.
- The PN waits for the calculated delay threshold and then proceeds to the next entry in the table.
- If an context stored in the internal table terminates, or it reaches the reduced usage threshold level, the session is processed with priority and the internal table is updated accordingly.

At each charge confirmation report , the PN reports back the service usage (of time or data) used before the tariff switch event and the service usage after it. These two values are referred to as first portion usage and second portion usage (in the case where there is no tariff switch, the entire usage is termed the first portion and the second portion is set to zero). With this information, the external platform is able to calculate accurately the corresponding charge to be debited from the subscribers credit balance (pre-paid) or recorded in a charging event (post-paid), and return a new service increment threshold to the PN based on the new tariffs.

The mechanisms as described here can be applied to provide subscribers with pre-paid or post-paid access to packet data services. The external platform used for post paid subscribers is configured to automatically authorise a post-paid subscriber and return a pre-configured service increment to the PN. The PN operates in a similar manner for a pre-paid subscriber, activating triggers and generating charging events to the pre-paid platform. When the external platform used for post-paid subscribers receives a charge confirmation report for a post-paid subscriber it generates a call detail record (CDR) for the subscriber's usage rather than debiting credit from a subscriber's account. The CDR's would then be picked up and processed using the normal post-paid billing systems.

Additional detail relevant to the implementation of control of packet services is described below. The contexts are represented within the PN in an internal format tailored to their efficient processing within the PN. A configuration layer is also defined within the PN that is responsible for establishing a suitable communication protocol to the external system in accordance with the standards that may apply for a particular network technology. For example, in the case of a GPRS network as described above, these operations could be formatted into a representation conformant with the CAMEL Phase 3 specification, and transported using the standard CAMEL Application Part (CAP) protocol. In another network configuration, the external operations could be formatted into a RADIUS message and transported over a standard IP network. With this capability, the PN is easily adapted to different network technologies and to communicate with pre-paid and post-paid systems that use standard network interfaces.

The PN is deployed in the network as a highly available and scaleable node. The PN is deployed as a multi-node cluster, in which individual nodes may operate either in a load-sharing mode, or in a standby mode as required by the network operator. In load-sharing mode, each node in the cluster operates as a live system. If one node should fail, live traffic is routed via the remaining nodes in the PN cluster, i.e. a node failure results in some loss of capacity but no loss of service. This cluster arrangement provides a highly scaleable PN. In standby mode, one of the nodes in the cluster is configured as a standby node. If one node should fail, the traffic for the failed node is re-routed automatically to the standby node, which replaces the failed node in the cluster, i.e. a node failure results in no loss of capacity.

In a minimum configuration, the PN is deployed as a dual node cluster, operating in either load-sharing or standby mode.

It will be appreciated that the invention provides for considerably simpler implementation of prepaid services in GPRS and other packet technologies for mobile networks. Furthermore, the invention provides a high level of flexibility to support

service differentiation in networks. Some examples of the application of service differentiation to enhance the quality of service offered to subscribers are:

- The subscriber can avail of premium content services that reflect advertised charges for access to the content, i.e. no incremental charges for transport of the content are incurred.
- For download services, a charge is incurred only on successful completion of the download operation. If the download operation fails before completion, no charges are incurred. Without this flexibility, a subscriber could be charged for every packet in an incomplete download operation and then incur the charges a second time during a subsequent (successful) download operation.
- The subscriber can send and receive MMS messages based on the advertised charge for sending (or receiving) MMS published by an operator. There are no incremental charges for transport of the MMS content either during the send or receive operations.

The PN can interface with entities other than the SGSNs, such as CDMA, TDMA, UMTS, and wireless LAN entities and negates the need for triggering mechanisms in these entities. Thus, the network operator can focus all service control functionality in a limited number (often only one pair, for redundancy) of PNs and external platforms. The PN platform can, be used for a multitude of service contexts without having to develop multiple interfaces to multiple network entities. Accounting for a single subscriber using multiple access methods is simplified. For example, a subscriber may use their GPRS enabled device with prepaid billing from their GSM prepaid account. They may then switch to a wireless LAN access method but still be billed to their GSM account. The prepaid system only interacts with the PN to provide this prepaid functionality rather than interfacing with multiple SGSNs or wireless LAN access point controllers.

The invention is not limited to the embodiments described but may be varied in construction and detail.

Claims

1. A method of controlling data services usage in a mobile data network, the method comprising the steps of:

a network service node routing a subscriber packet data session to a packet node;

the packet node inspecting the packet data and determining a current context of the data session;

the packet node determining a charging mechanism according to the current context; and

the packet node monitoring service usage according to the charging mechanism and notifying a charging platform for charging the subscriber.

2. A method as claimed in claim 1, wherein the packet node determines a charging mechanism according to the current context and subscriber information determined from inspecting the packet data session.

3. A method as claimed in claim 2, wherein the packet node selects one of a plurality of pre-stored charging mechanisms.

4. A method as claimed in any preceding claim, wherein the packet node dynamically receives monitoring usage parameters from the charging platform during the session.

5. A method as claimed in claim 4, wherein the packet node invokes an operation on the charging platform when a usage parameter threshold is exceeded.

6. A method as claimed in claims 4 or 5, comprising the further step of the charging platform transmitting an instruction to the packet node instructing a change of the current context, and the packet node changing the context accordingly, and

dynamically changing the charging mechanism in response to the context change.

7. A method as claimed in any preceding claim, wherein a network service node selects the packet node for routing the packet data session according to a subscriber record.

8. A method as claimed in claim 7, wherein the subscriber record includes an address of the packet node in an access name field.

9. A method as claimed in any preceding claim, wherein the charging mechanism causes the packet node to initially request authorisation from the charging platform for full activation of a context.

10. A method as claimed in claim 9, wherein a single authorisation relates to a plurality of usage thresholds.

11. A method as claimed in any preceding claim, wherein the packet node switches from one tariff to another for usage monitoring and dynamically updates usage thresholds accordingly.

12. A method as claimed in claim 11, wherein the packet node switches tariffs in response to an instruction from the charging platform.

13. A method as claimed in claims 11 or 12, wherein the packet node splits a charging increment into portions separated by a tariff switch event.

14. A method as claimed in any preceding claim, wherein the packet node holds previous contexts and subsequently re-establishes at least one previous context.

15. A method as claimed in any preceding claim, wherein the charging platform is a prepaid platform, and the packet node notifies the prepaid platform of usage sufficient to decrement a subscriber's account.

16. A method as claimed in any of claims 1 to 14, wherein the charging platform is a post-paid billing platform and the packet node notifies the billing platform of usage sufficient to calculate a charge against the subscriber's billing account.

17. A method as claimed in any preceding claim, wherein the network is a GPRS network, and the packet node emulates an SGSN or a GGSN.

18. A method as claimed in any preceding claim, wherein the packet node dynamically chooses one of a plurality of charging platforms according to the selected charging mechanism.

19. A method as claimed in any preceding claim, wherein an MMSC includes a charging indicator in a URL for sending or receiving a multi-media message, and the packet node uses this indicator to determine a charging mechanism.

20. A method of controlling data services usage substantially as described with reference to the accompanying drawings.

21. A packet node comprising means for performing packet node operations of a method as claimed in any preceding claim.

22. A charging platform comprising means for performing charging platform operations of a method as claimed in any of claims 1 to 20.

23. A computer program product comprising software code for performing steps of a method of any of claims 1 to 20 when executing on a digital computer.

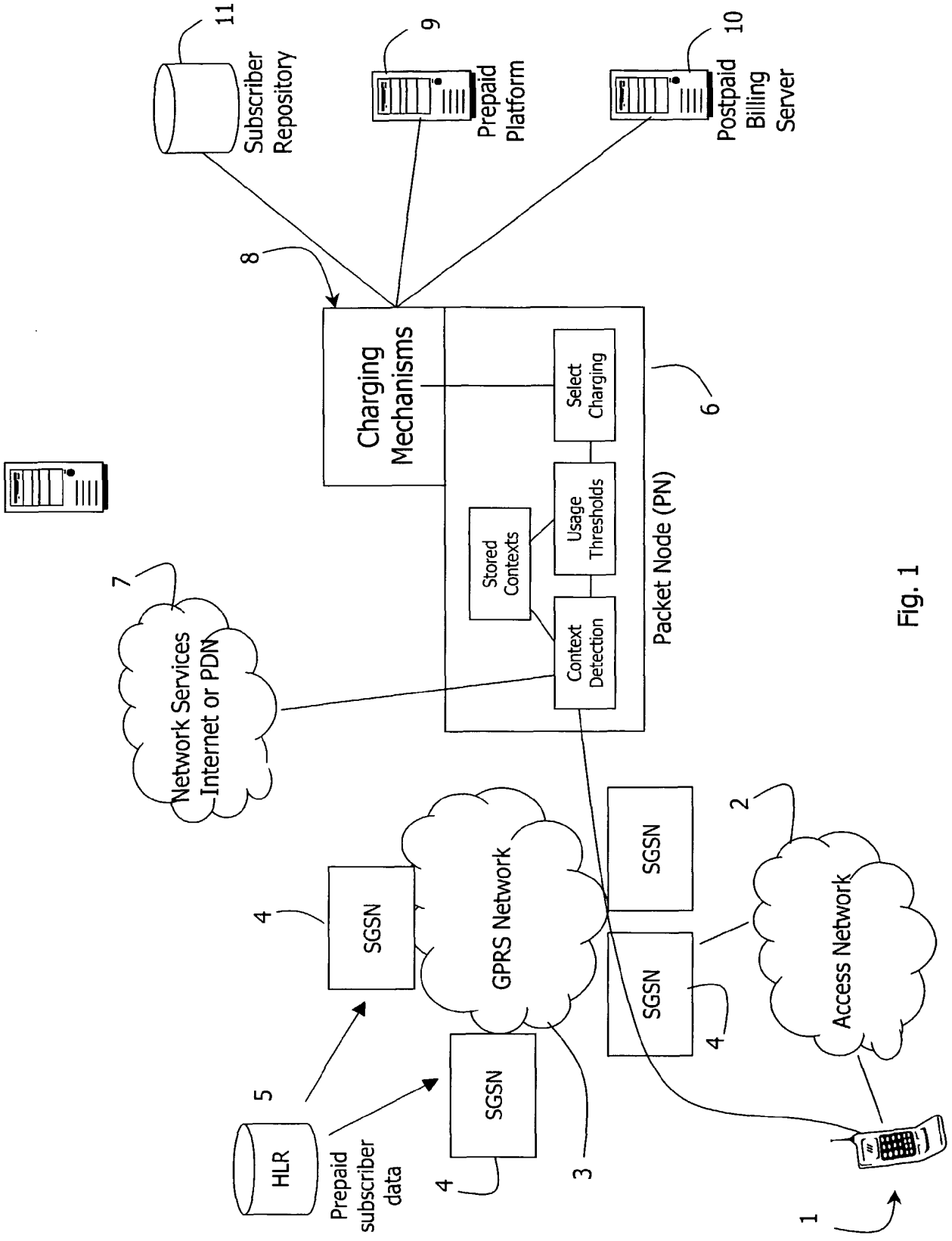
11
Subscriber Repository
9
Prepaid Platform
10
Postpaid Billing Server
8
Charging Mechanisms
Select Charging
Usage Thresholds
Stored Contexts
Context Detection
Packet Node (PN)
6
7
Network Services Internet or PDN
4
SGSN
GPRS Network
SGSN
SGSN
4
2
Access Network
5
HLR
Prepaid subscriber data
4
SGSN
3
1

Fig. 1

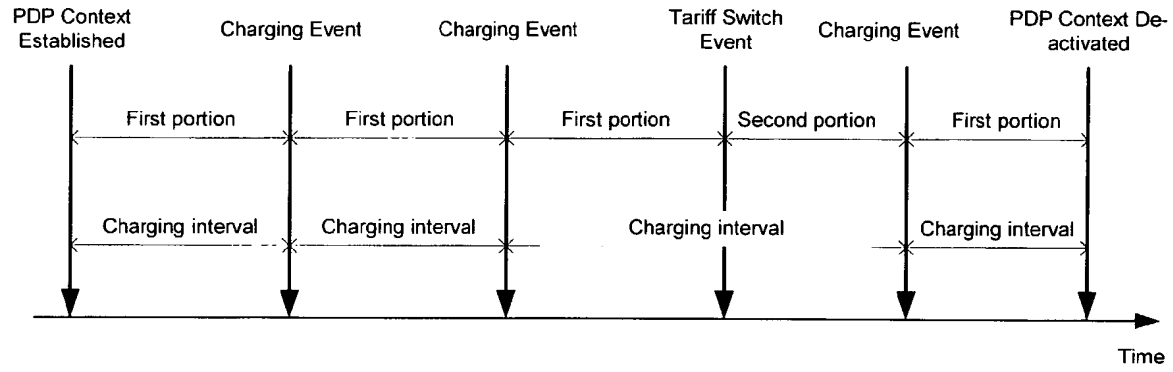
PDP Context Established
Charging Event
Charging Event
Tariff Switch Event
Charging Event
PDP Context De-activated
First portion
First portion
First portion
Second portion
First portion
Charging interval
Charging interval
Charging interval
Charging interval
Time

Fig. 2